

# Climate Risk and Impact Assessment

# ABOUT US

**The Energy and Resources Institute (TERI)** is a not-for-profit research organization working in the fields of Energy, Environment and Sustainable Development

**Climate Change Research:** Focuses on addressing the knowledge gaps in climate change science and its regional implications to effectively link climate science to policy research and aid in better preparedness. Conduct cross-sectoral research to comprehend better how climate change is affecting various sectors.

We work in collaboration with various stakeholders including national and international governments, bilateral and multilateral agencies, foundations, research institutes corporates, NGOs civil society and sector experts

# Climate modelling research at TERI

- Global and Regional Climate Projections
- Understanding the spatial–temporal scales of climate variability using the different climate models
- Monsoon variability over the different regions in the tropics
- Analysis of variability in intensity and frequency of rainfall and temperature extremes
- Research on drivers of extreme precipitation events in warming climate
- Application of AI/ML tools for seasonal prediction, statistical downscaling, bias-correction etc
- Application of climate modeling for risk assessments
  - Cyclone detection and hazard risk mapping
  - Sea level rise and its impact on coastal inundation
  - Integrated impact assessments
  - Multi-hazard risk mapping
  - Assessment of renewable energy generation potential
  - Climate risk over environmental hotspots like wetlands, high mountain ecosystems etc
  - Impacts of climate change on various sectors like agriculture, infrastructure, water resources and health
  - Urban Heat Island assessment



# Impact and Risk assessment

- TERI works closely with communities, national, sub-national and local actors to devise strategies and solutions for effective and efficient resource utilization and risk management.
- We conduct climate risk and impact assessments across sectors.
- We provide means and technologies to industries and businesses to assess their risk and vulnerability for their assets, operations, infrastructure, and services.
- We also provide mitigation and adaptation intervention to ensure business continuity and sustainable development.
- We develop solutions for disaster management and physical risk analysis such as forecasting and early warning systems, flood and drought assessment, heat stress management, coastal disaster management, and storm surge assessments.





## Research

- Relation between Sea-Ice loss and Indian Summer Monsoon.
- Improving the understanding of climate processes and its linkages at regional scales, especially under the growing extreme climate events.
- Development of Flood Warning System for studying the potential impact of flooding and identification of flood prone areas in north eastern India.



## Policy Linkages

- State Action plans on climate
- State/ district level climate vulnerability plans
- Industry level risk assessment plans
- City level flood management plans
- Near real time flood forecasting for cities
- Climate Tool for decision makers
- Training: research schools and workshops for stakeholders and policy makers



## Services

- Climate projections at regional scale under AR4/5 scenarios.
- Climate Risk assessment specific to various sectors.
- Cyclone detection and Hazard Risk Mapping
- Sea level rise and its impact upon coastal inundation
- Multi-hazard risk mapping and Integrated Impact Assessment
- Outreach and Training

# Our Work

## Storm Surge and Flood risk assessments

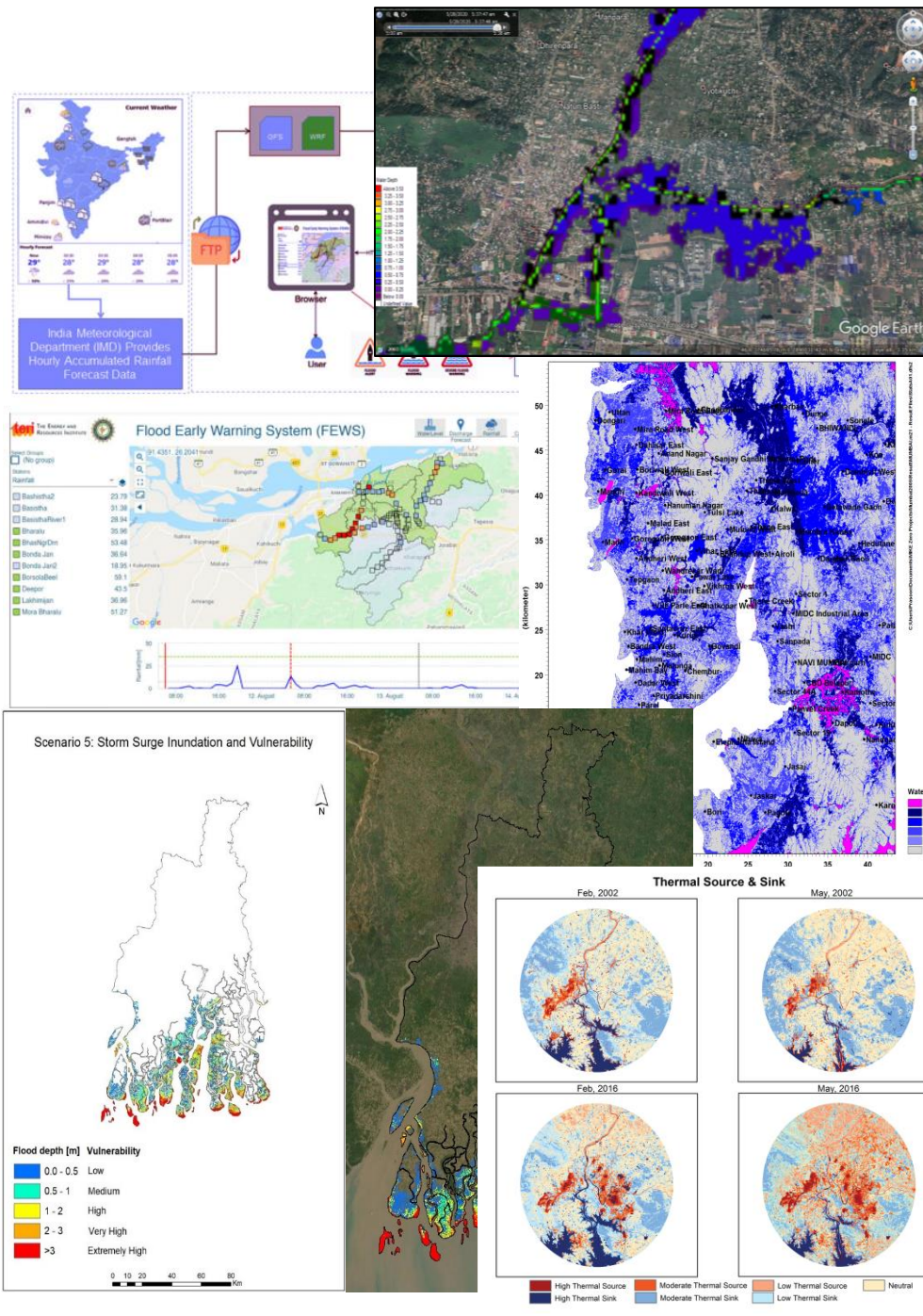
Storm Surge assessment and coastal inundation vulnerability analysis, flood risk analysis, Basin scale flood analysis and risk assessments

## Climate and disaster risk assessment for Businesses and industries

Assess climate change-induced risks to infrastructure and services for various industries and businesses and provide possible risk mitigation measures

## Urban Solution

Weather related disaster and climate risk analysis for urban areas. Develop solutions like Flood Early Warning System for urban flood forecasting and early warning, Urban heat island study and heat stress management in cities to enhance urban resilience and disaster management

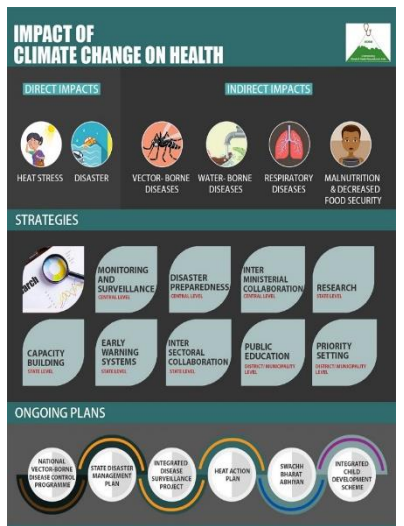
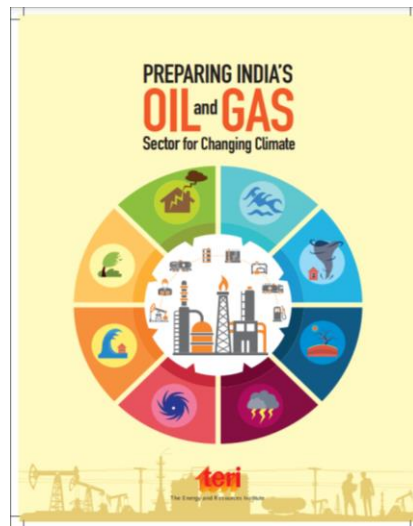
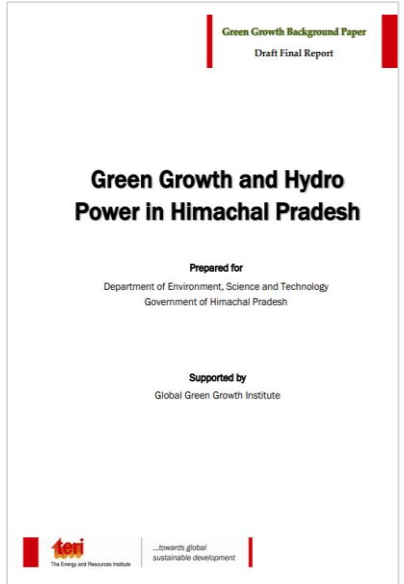
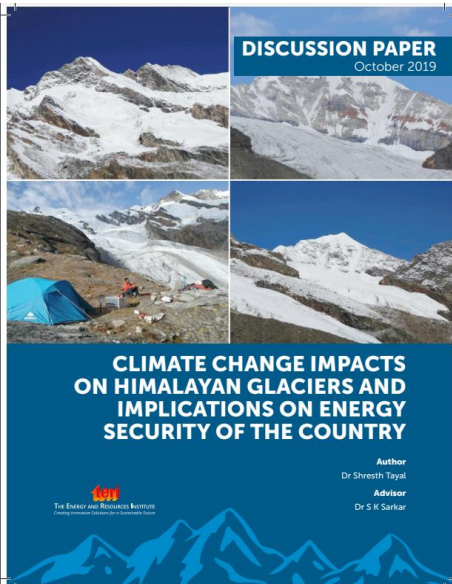


# Sectoral Climate Risk Assessment

Assess climate change-induced impacts and risks on strategically important sectors such as:

- ✓ Energy
- ✓ Agriculture
- ✓ Environment
- ✓ Water Resources
- ✓ Power Generation
- ✓ Health
- ✓ Forest

At local, national and sub-national scale



# Services

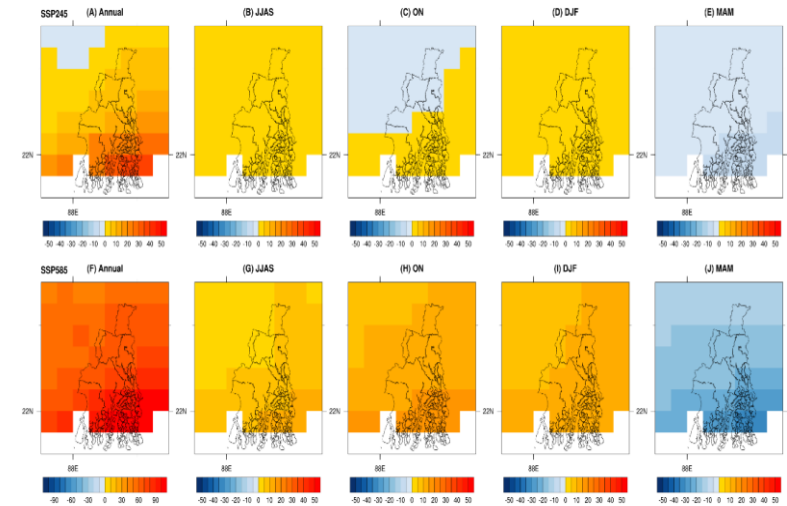
## Development of future climate profiles for Indian Sundarbans and the Arkavathy River Basin

### Objective:

- To assess the future climate scenarios and their impact on Indian Sundarbans and the Arkavathy River Basin.
- Assess the projected climate extremes pattern over Arkavathy river basin and Indian Sundarbans under a warming climate.

### Outcomes:

1. Identified historical climate trends, major environmental risks and expected climate variability in future under different socio-economic pathways (SSP) for the study locations.
2. The Arkavathy river basin is projected to get drier in future while the Sundarbans will face heightened risk due to storm surges exacerbated by rising sea level.





# Services

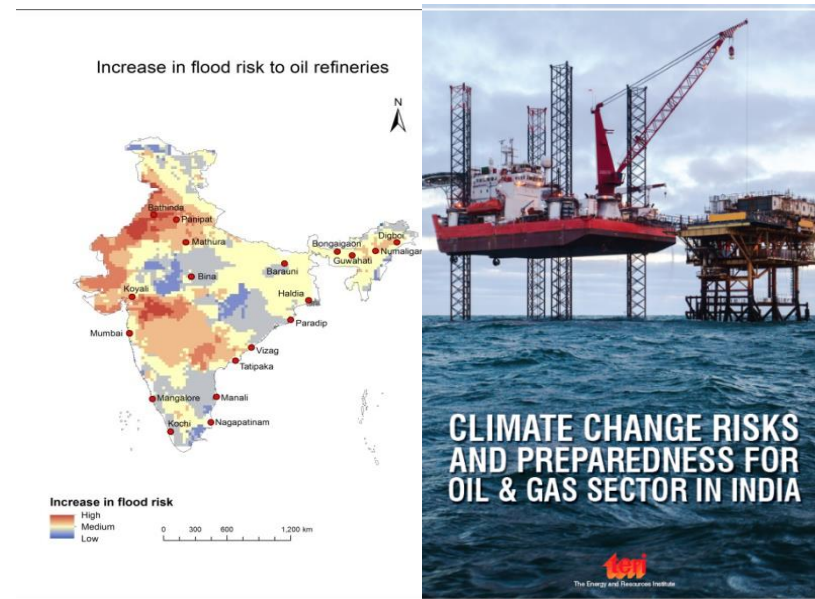
## A Study on Climate Change Risks and Preparedness for Oil & Gas Sector in India

### Objective

- To understand possible climate risks and vulnerabilities to existing upstream, midstream, and downstream infrastructure and operations of oil and gas industry in India.

### Outcomes:

- The future storm surges on the East Coast would be 15-20% higher than the historical pattern, particularly at Visakhapatnam, Kalingapatnam, Gopalpur, Paradip, False Point and Short Island stations
- The Inland peninsula and the North-Western region show relatively higher percentage (18% to 32%) contribution from high rainfall days towards the total rainfall in future.



# Services

## Sector-specific climate risk assessments

Assessment of climate risks relevant to specific sectors such as infrastructure, water resources, and power plants

### Outcomes:

- The frequency of cyclonic storms will increase in future periods compared to baseline over Arabian Sea regions.
- Heavy, very heavy and extremely heavy precipitation is projected to increase substantially in future, need to develop flood mitigation strategies.
- The hot days, very hot days and extremely hot days show substantial increase towards the mid-century, leading to higher energy consumption and reduced efficiency of industrial equipment.

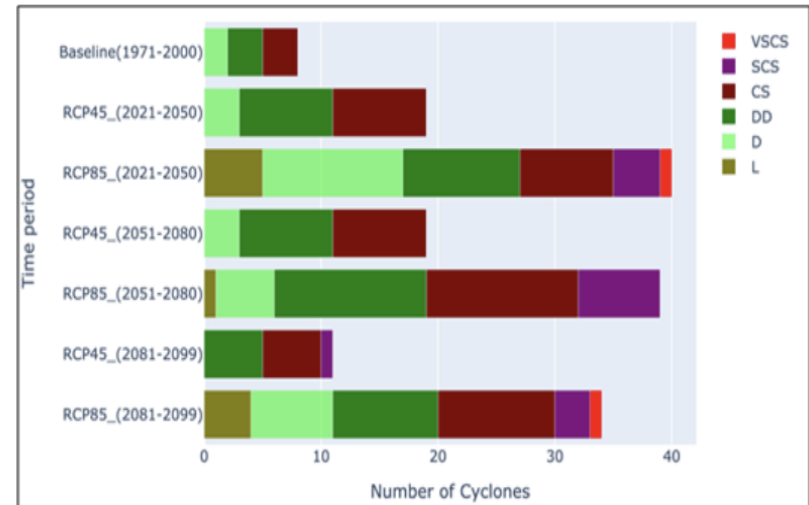


Figure 58 Projected frequency of cyclones over Arabian Sea



# Services

- Planning climate resilient coastal cities: learnings from Panaji and Vishakhapatnam
- Climate resilient infrastructure services
- Climate resilient green growth strategies for Himachal Pradesh
- Climate resilient green growth strategies for Punjab
- Climate assessment over Urban local bodies(ULB's)
- Development of climate resilience plan for municipal corporations
- Assessment of Urban Heat Island (UHI) effects

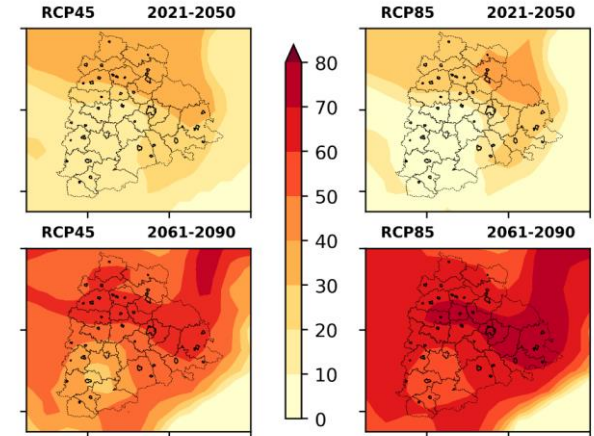
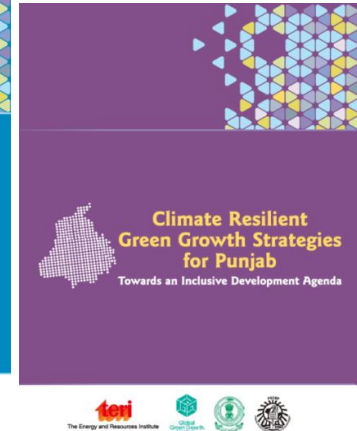
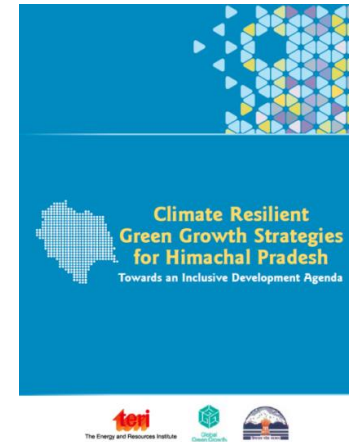
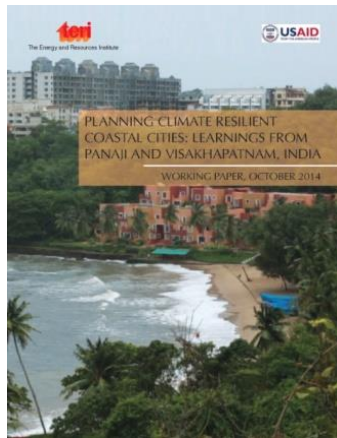


Fig. Additional number of days per year (MAM season) with  $T_{max}$  above 40°C for two scenarios (RCP4.5 and RCP8.5), for the near future (2021-2050) and long term future (2061-2090). The figure is centered over the telangana region.

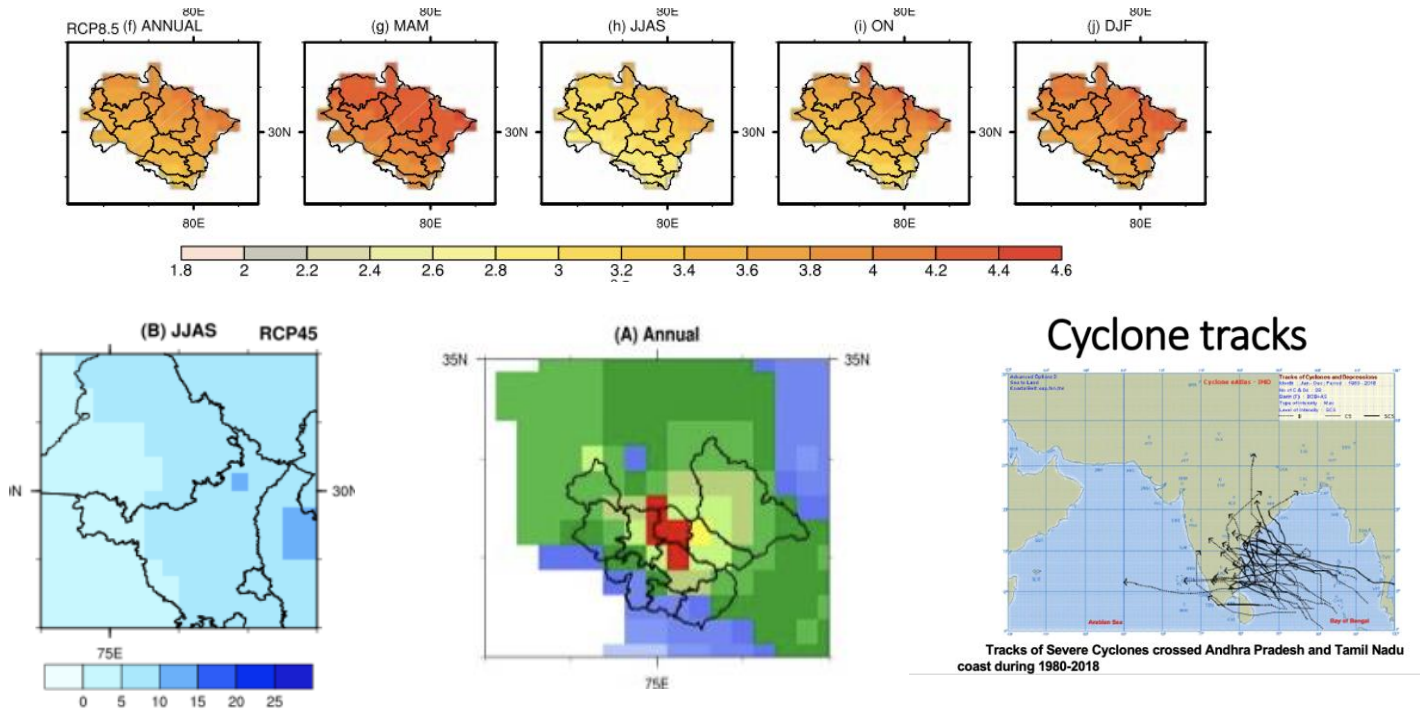


# Policy Linkages

## State Action Plan on Climate Change (SAPCC)

Center for Climate Modelling provides inputs to state action plans in the form of assessment of present and future projected climate risks relevant to the location which forms a separate chapter in the SAPCC and forms the basis for vulnerability assessment and mitigation planning

States: Maharashtra, Gujarat, Puducherry, Uttarakhand, Jammu & Kashmir and Chandigarh



# Policy Linkages

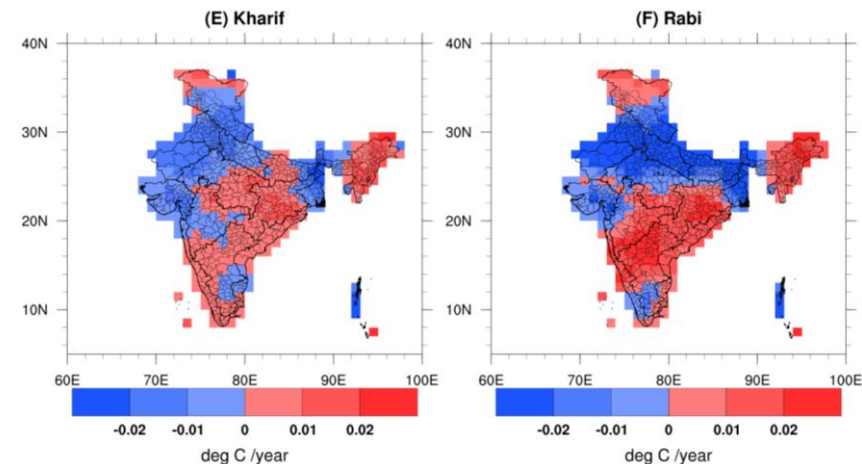
## Impact of agriculture on climate change

### Objectives:

- a) Assessment of present and projected future impacts of climate change over agro-climatic zones (ACZs) of India.
- b) Understand how extreme weather events like droughts, floods and extreme precipitation events will impact agriculture

### Outputs:

1. Climate change has altered precipitation patterns and affected crop production through factors such as shifts in growing season, changes in planting dates
2. Rising temperatures and decreasing DTR will lead to reduce crop productivity over several ACZs



Diurnal Temperature Range trend



# Research

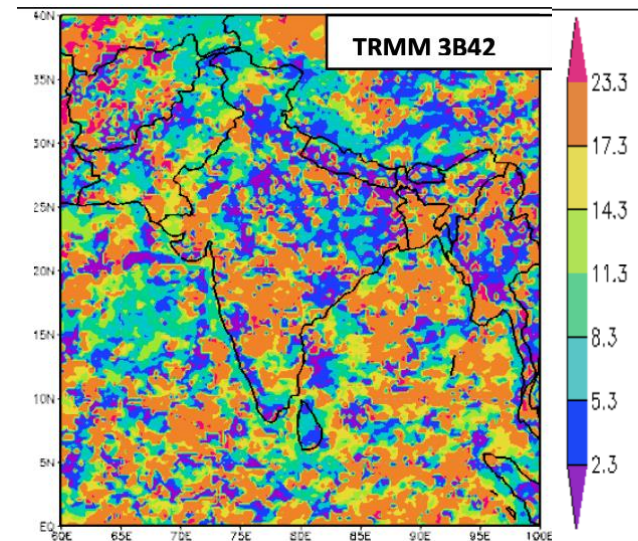
## Diurnal variability of convection and precipitation and its sensitivity to physical parameterization using UKMO-Unified Model

### Objective:

- To improve the understanding of diurnal variability of monsoon convection & precipitation over the Asian monsoon region using both observations and models.
- To understand the sensitivity of diurnal variation of convection and rainfall to physical parameterizations and model resolution and improving the representation of diurnal variation in the UKMO UM.

### Outcomes:

- Over the Bay of Bengal, the coastal regions show an early morning (0230-0530 hrs IST) peak and there are multiple modes of the peak octet of diurnal rainfall at 1130 hrs, 1430 hrs, and 1730 hrs IST moving southwards from Head Bay.
- West coast of India and Himalayan foothills was found to have an early morning rainfall (0230 IST), while Central India receives maximum rainfall at 1730 IST.



# Research

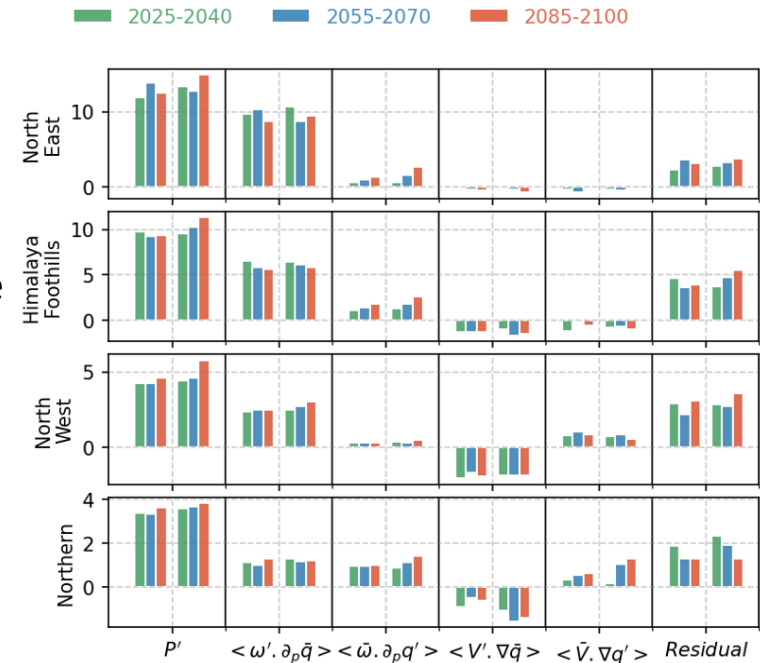
## EPICC (East-Asia Peru India Climate Capacities)

### Objective:

- Phase 1 (2018-2021): Understanding the statistical properties of climate extremes over India
- Phase 2 (2021-2023): Understanding key drivers of extreme precipitation events over India in a warming future.

### Outcomes:

- Phase 1: Climate change poses significant threats to life and livelihood in Uttarakhand pushing inhabitants to migrate.
- Phase 2: Identified dynamic processes to be a major contributor to extreme precipitation events while future projections suggest a greater contribution by increased vertical moisture advection in a warmer atmosphere



# Research

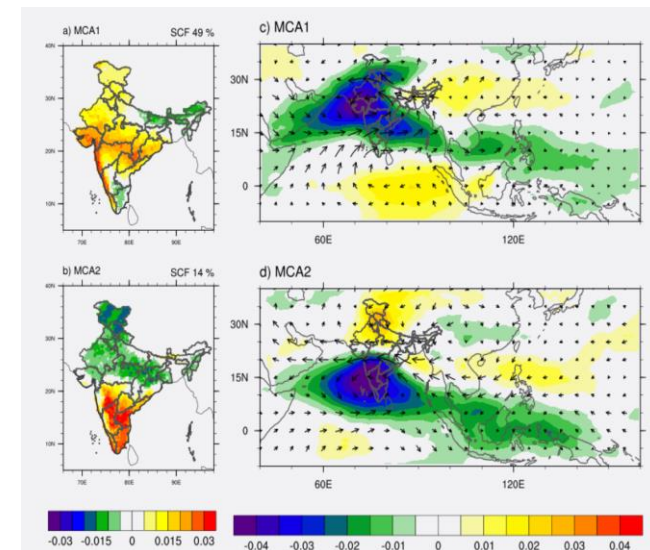
## Preparing for the Future: Designing Climate Products and Models for India (PREPARE)

### Objective:

- a) Improving understanding of climate processes and its linkages at regional scales, especially under the growing extreme climate event narrative using state-of-art dynamical modelling products, such as those from the CORDEX Project, and statistical downscaling techniques.
- b) Carrying out development of a multi-temporal forecasting system, specific to India, which would help tailor climate services for stakeholders and users' needs.

### Outcomes:

1. Generated granular information to prepare against extreme climate events, climate services enhancement and robust mainstreaming of climate information in policy planning
2. Developed a multi-temporal forecasting system for India with focus on policy relevant information (climatic indices, drought indices, warm and cold spells, or growing season length)





# Research

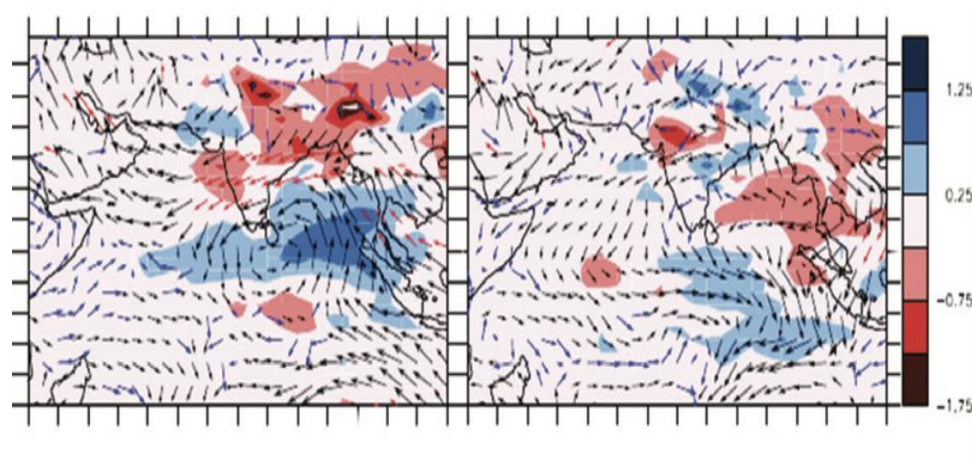
## C-ICE: Counteracting effect of future Antarctic sea-ice loss on projected increases of summer Monsoon rainfall

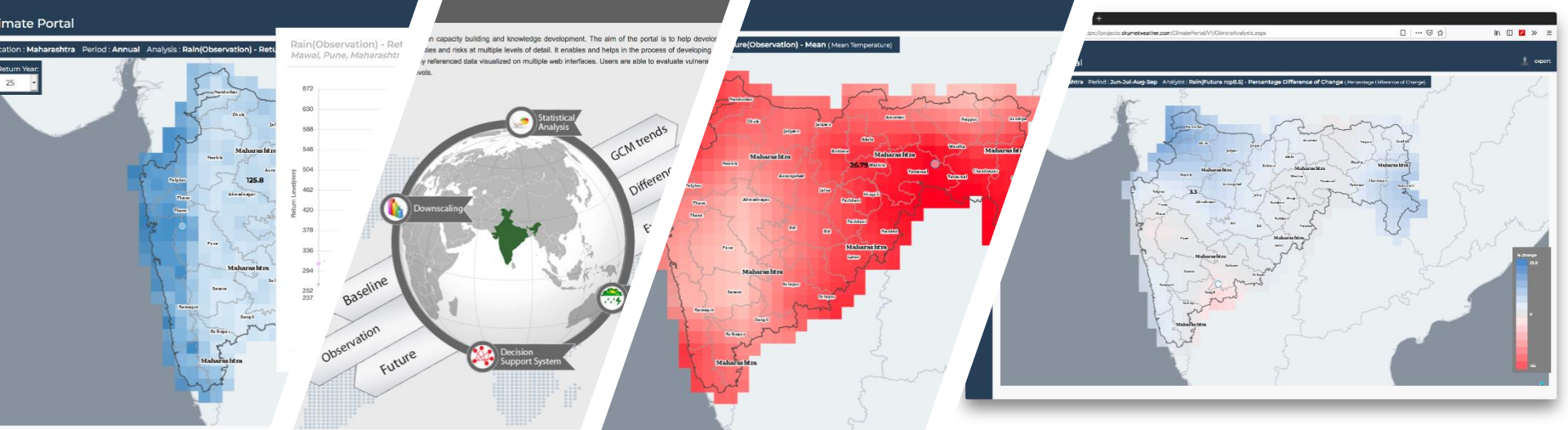
### Objective :

- To understand the potential impact of Antarctic sea-ice loss on the Indian Summer Monsoon (ISM), focusing on atmospheric large-scale circulation dynamics involved in the teleconnection linking remote changes in the extra-tropics to the tropical monsoon dynamics.

### Outcomes:

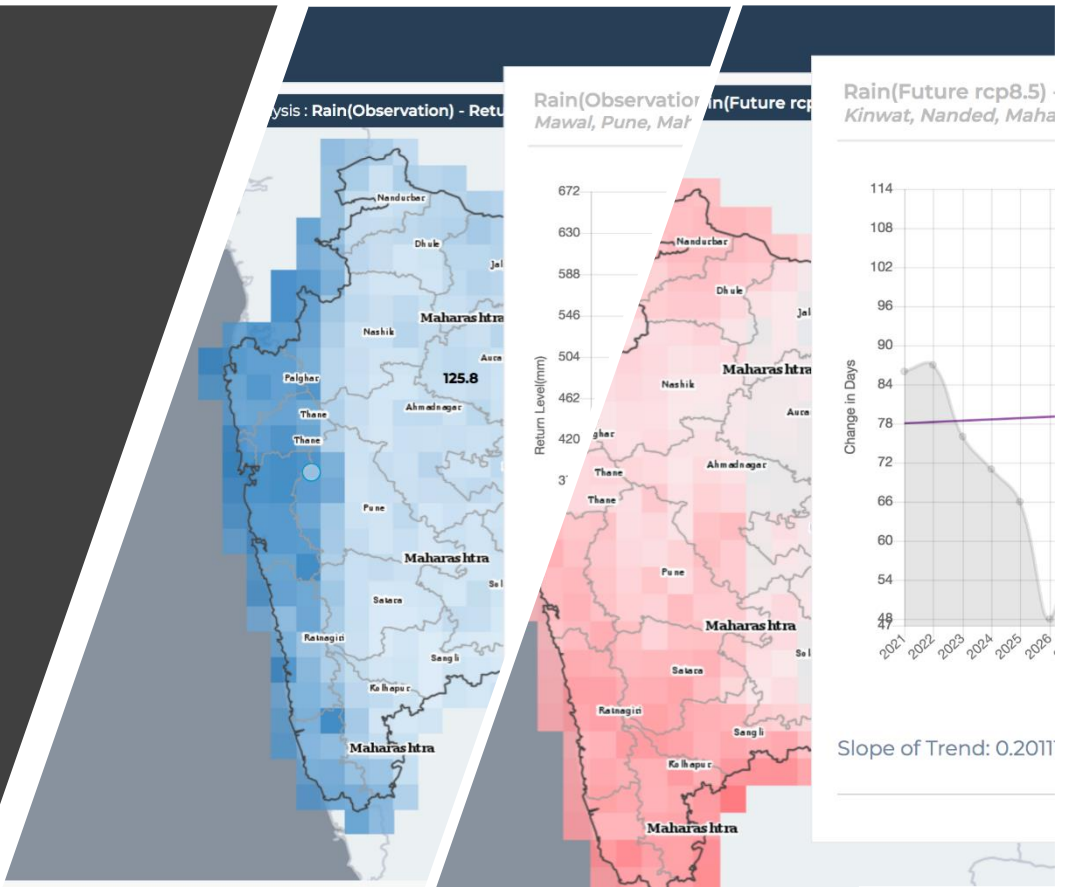
- The autumn sea ice area in the Antarctic sea-ice is related to the central Pacific sea surface temperature. Reduction in Antarctic Sea ice area warms the central Pacific Ocean which in turn causes reduced rainfall during Indian Summer monsoon season



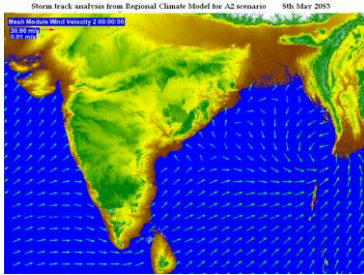


# Tools

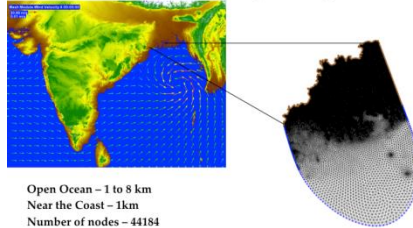
- Teri Climate Tool (TCT)
  - Developed an interactive tool that provides local scale climate information over India.
  - Enables easy access to high resolution projections of future climate and climate extremes such as droughts, floods and extreme precipitation events.
  - <http://tct.teriin.org/>



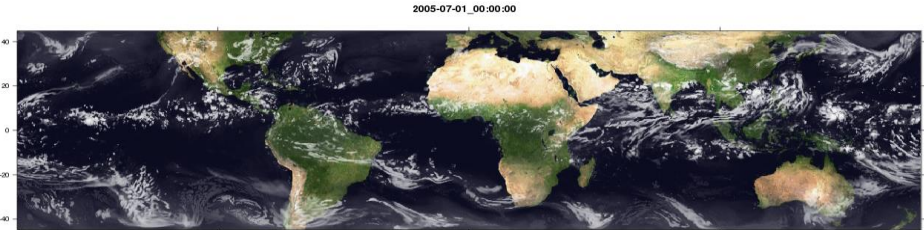
# Modelling Products/Services



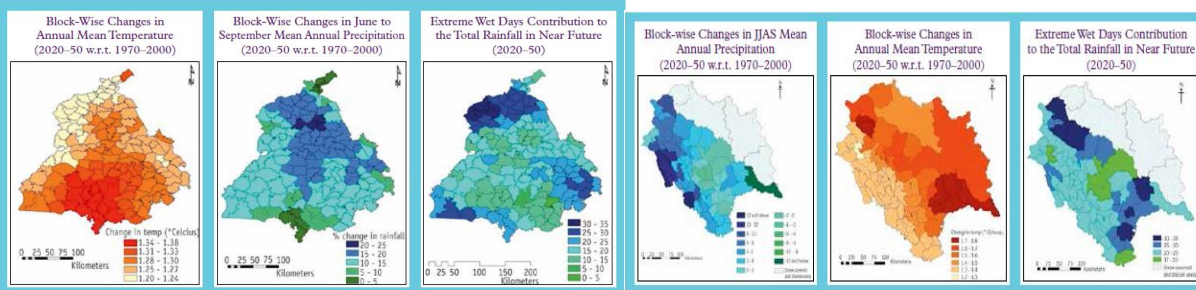
**2DDI- Coastal grid for computations of Storm surges over Bay of Bengal**



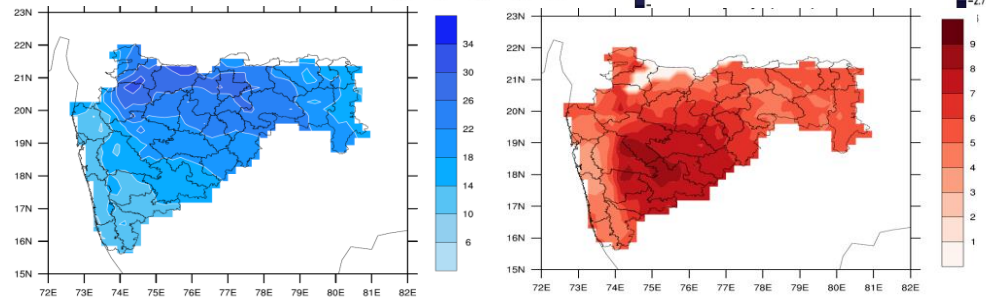
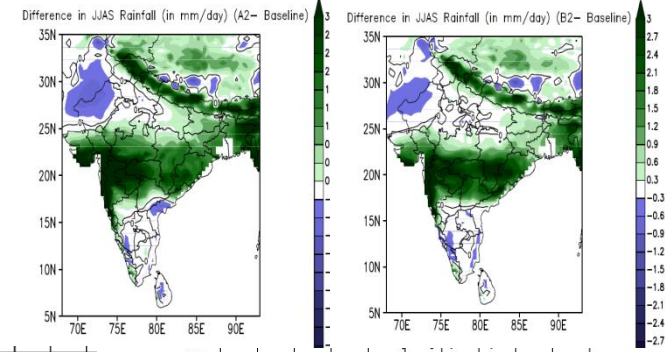
Open Ocean – 1 to 8 km  
Near the Coast – 1 km  
Number of nodes – 44184  
Timestep- 5 seconds



TERI Uni Bjerkes Centre (36 km WRF simulation) - Veldore, Mesquita, Lunde, Bhardwaj and Machineni (2011)



## Extreme Scenario Moderate Scenario



## Contact

Muriki Santosh Kumar & Prason Singh  
Earth Science and Climate Change Division,  
TERI, India Habitat Centre, Lodhi Road, New  
Delhi - 110 003

T: 91-11-24682100/11, 41504900 (extn. 2346)

[Santoshkumar.Muriki@teri.res.in](mailto:Santoshkumar.Muriki@teri.res.in);

[Prason.singh@teri.res.in](mailto:Prason.singh@teri.res.in)

